DOCUMENT RESUME

ED 191 724 SE 032 754

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TITLE The Mathematical Thinking of Poor Inner City Children.
PUB DATE Apr 80
NOTE 7p.; Paper presented at the Southeastern Conference on Human Development (Alexandria, VA, April 1980). Contains broken type.

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Age Differences; Arithmetic; Basic Skills; *Cognitive Ability; Cognitive Development; Cognitive Processes; *Disadvantaged Youth; Kindergarten Children; *Learning Problems; Mathematical Concepts; *Mathematics Education; Preschool Children; Problem Solving; *Racial Differences; Social Differences; *Socioeconomic Background; Student Characteristics
IDENTIFIERS *Mathematics Education Research

ABSTRACT

This study investigated whether young, poor, inner-city children are deficient in the mathematical skills and concepts necessary for later success in school arithmetic. Children of pre-kindergarten and kindergarten age, black or white, and lower class or middle class, were given a wide variety of mathematical tasks, including Piagetian measures, tasks assessing counting skills and the use and understanding of counting in problem solving, judgment of more, understanding of addition operations, and tasks involving written numbers. Results showed consistent differences on almost every task reflecting improved performance with age, but only minor social class or racial differences. The conclusion is that all children from all of the groups possess the cognitive competence necessary for later success in school arithmetic. (MP)

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The Mathematical Thinking of Poor Inner City Children[1]

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Abstract

This study investigates whether young, poor, inner city children are deficient in the mathematical skills and concepts necessary for later success in school arithmetic. Children of of pre-kindergarten and kindergarten age, black or white, and lower class or middle class, were given a wide variety of mathematical tasks, including Piagetian measures, tasks assessing counting skills and the use and understanding of counting in problem solving, judgment of more, understanding of addition operations, and tasks involving written numbers. Results showed consistent differences on almost every task reflecting improved performance with age, but only minor social class or racial differences. The conclusion was that children from all of the groups possess the cognitive competence necessary for later success in school arithmetic.

SE 032 754

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[1] Presented at the Southeastern Conference on Human Development, Alexandria, Virginia, April 1980.

The Mathematical Thinking of Poor Inner City Children

For many years there has been a controversy regarding the cognitive competence of poor children. This general issue is investigated here through an examination of the mathematical thinking of young and poor children who reside in the inner city. The purpose is to determine whether poor children, who later show low levels of academic achievement, possess the basic mathematical skills and knowledge necessary for success in school arithmetic.

Despite the heated nature of the controversy, evidence concerning poor children's intellectual abilities is sparse, particularly with regard to mathematical thinking. The only directly relevant study located compared the numerical abilities of Head Start children (both black and white) with those of middle class nursery school children (Kirk, Hunt, and Volkmar, 1975).[1] Head start children performed at a significantly lower level than middle class children. These differences were of large magnitude. However, the authors reported that their tasks "taxed the children.....The tasks evoked efforts to leave the field and escape the examiner" (p. 137). Thus, the procedures may not have been maximally effective in assessing the children's competence.

In a previous study, the present authors compared the mathematical thinking of 25 lower class, inner city nursery school

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[1] Kirk, G.E., Hunt, J. McV., & Volkmar, F. Social class and preschool language skill: V. Cognitive and semantic mastery of number, Genetic Psychology Monographs, 1975, 92, 131-153

(mean age of 4-1/2 yrs.) with that of 38 middle class black and white nursery school children (mean age of 4-1/3 yrs.). All children, tested individually, were given tasks assessing perception of more, conservation of number, addition operations, rote counting, enumeration, cardinality, and addition calculation. The results showed that, on perception of more, addition operations, and addition calculation, middle class children performed at a higher level than inner city children. On the other tasks, group differences were not significant. However, even on those tasks where the inner city children performed below the middle class children, most inner city children showed some competence and displayed a similar pattern of performance as did the middle class children. The results were interpreted as showing a complex pattern of deficiency and competence in the performance of the inner city children. The notion of a general cognitive deficit thus seems inappropriate.

This study is a further investigation of the mathematical thinking of poor, inner city children. One purpose is to explore whether improved testing procedures may more effectively elicit the cognitive competence of poor children. In light of the results of our previous study, the primary purpose is to define the specific nature of the cognitive strengths and deficits, if any, which exist among poor children in the area of mathematical thinking.

Children of pre-kindergarten (4 yrs. old) or kindergarten (5 yrs. old) age, who were black or white and from lower class or

middle class backgrounds, were each interviewed individually in two sessions. All children attended all day child care programs in the Baltimore/ Washington D.C. area. The lower class children resided in the central or "inner" city, whereas middle class children typically resided in suburban areas. There were 18 children in each of the 8 cells formed by the factors of age, social class, and race, for a total of 144 children. Data concerning each child's gender and family status (intact or single parent home) were included in the subsequent data analysis, although no attempt was made to provide equal numbers of subjects for these factors.

Each child was given a variety of mathematical tasks to assess the broad range of young children's mathematical knowledge. The tasks included Piagetian measures (conservation of number, seriation); counting tasks (rote counting, enumeration); tasks involving the understanding of counting (order invariance, unit rule, quotity, abstraction principle, cardinality) and the use of counting (repair sets, addition calculation); understanding of addition operations; judgment of more; and tasks involving written numbers (reading and writing numbers, representation of cardinality). The procedures for the tasks were developed on the basis of our experience from the previous study and extensive pilot testing and thus, were not identical to the procedures used in the previous study. Most tasks were designed as games, which the children seemed to enjoy. Testers spent a morning or two in each classroom to become acquainted with the children before any testing was done.

An examination of the results showed that the only consistent main effect across all tasks was that for age. Kindergarten (K) children performed significantly better than the pre-kindergarten (PK) children on every task except the abstraction principle, where both groups performed at the ceiling. But for most tasks, even a majority of PK children exhibited some competence. The age changes generally indicated a gradual improvement with age rather than any dramatic qualitative differences. For example, the PK children generally counted set sizes of 8 and below accurately, but counted sets larger than that with uneven accuracy, whereas the K children were more accurate on the larger sets. K children approached the ceiling on all of the tasks except conservation of number, equivalence, and addition calculation with no objects present. Thus, the K children possessed strong competence in a wide variety of mathematical concepts and skills.

Significant differences for the other subject variables were scattered, of a lesser magnitude than the age differences, and revealed no strong patterns. Middle class children significantly higher than inner city children on the conservation of number, which number is greater, judgment of equivalence, cardinality, and addition calculation tasks. However, the differences for the which number is greater and cardinality tasks were primarily restricted to the higher performance of the PK middle class children over the PK inner city children, with kindergarten groups being roughly equal. White children scored significantly higher than black children on only two tasks, seriation and the unit rule. Children from intact families scored significantly

scored significantly higher than those from single parent homes on the order invariance, seriation, reading numbers, and representation of cardinality tasks, but again, kindergarten groups were roughly equal on three of these tasks, restricting the differences primarily to the higher performance of PK children from intact families over PK children from single parent homes. These subject variables were also involved in a small number of more complex interactions which show no consistent pattern. Although there were several interactions involving gender, there was no consistent pattern favoring boys or girls.

In our previous study, middle class children outperformed the inner city children on the judgment of more, addition operations, and addition calculation tasks. Improved testing procedures apparently contributed to the lack of such differences between these groups on the judgment of more and addition operations tasks in this study.

In summary, developmental changes far outweigh the demographic factors such as race, family status, or social class in a consideration of children's mathematical thinking. PK children displayed surprising competence and K children showed a strong array of mathematical skills and knowledge. No evidence for a general cognitive deficit was exhibited by black or inner city children. Those differences which did exist were relatively minor. Sensitive testing procedures were more effective in eliciting the children's competence. From these results, we conclude that the children in all of the various groups in this study possess the cognitive competence necessary for later success in school arithmetic.